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OFFICE OF
PREVENTION,
PESTICIDES AND
TOXIC SUBSTANCES

MEMORANDUM

SUBJECT: Impact Assessment for Proposed Rodenticide Mitigation (DP 332577)

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EXECUTIVE SUMMARY

Most poisoning incidents involving exposure to second generation anticoagulant rodenticides occur in children less than six years old, companion animals, birds, and nontarget mammals. In order to reduce such poisoning incidents, the Agency is proposing to classify second generation anticoagulants as "Restricted Use," to require refillable (with bait blocks only) tamper-resistant bait stations for all consumer-use products with indoor uses, and to tamper-resistant bait stations for outdoor above-ground placements of second generation anticoagulants.

As part of the regulatory process involving rodenticides, BEAD evaluated the impacts of the proposed mitigations on rodent control and concluded that they will not affect rodent control programs and activities. Homeowners will still be able to control rodents either through pest control operators (PCOs), by means of baits (in bait stations), or by means of other cost-effective alternative methods, such as snap traps. The proposed mitigation requiring that second generation anticoagulants be classified as "Restricted Use" should not have an adverse impact on homeowners, because they will still be able to purchase baits (in bait stations) containing first generation anticoagulant and non-anticoagulant active ingredients. The proposed mitigation requiring that rodenticide baits be available to homeowners only in pre-baited (with bait blocks only), tamper-resistant bait stations will result in an increased cost for rodent control only for those households that choose to use rodenticide baits. Homeowners that are unable or unwilling to buy rodenticide baits will still be able to use alternatives such as snap traps. The proposed regulation requiring that above-ground placements of second generation anticoagulant rodenticide baits be only in tamper-resistant bait stations should not result in an increased cost for rodent control for PCOs since label language already requires the use of bait stations for outdoor uses of rodenticide baits.

INTRODUCTION

Background

In 1998, as part of a statutorily mandated reassessment of older pesticides, the U.S. Environmental Protection Agency (EPA) issued a Reregistration Eligibility Decision (RED) document for zinc phosphide and the Rodenticide Cluster RED, which included the active ingredients brodifacoum, bromadiolone, bromethalin, chlorophacinone, diphacinone, and pival. In those documents, EPA expressed concerns about rodenticide exposure incidents involving young children and potential adverse effects of rodenticides to birds and nontarget mammals. EPA announced plans to assess these risk categories further. The upcoming EPA mitigation decision will affect not only the active ingredients included in the "Rodenticide Cluster" RED, but also the active ingredients warfarin, difethialone, zinc phosphide, and cholecalciferol.

Warfarin, chlorophacinone, and diphacinone are first generation anticoagulants; brodifacoum, bromadiolone, and difethialone are second generation anticoagulants. Anticoagulants inhibit the formation of prothrombin, a key protein in the blood clotting

process, thus leading to capillary damage, internal bleeding, and eventually to death. Anticoagulants generally take at least four days from the onset of feeding until rodents begin to die. Bromethalin is a neurotoxicant that acts, after one or more feedings, by blocking nerve impulse transmission, causing paralysis of the central nervous system and respiratory arrest in approximately 2-4 days. Zinc phosphide is an acute poison that may kill a target rodent as the result of a single bout of feeding. Once ingested, zinc phosphide reacts with moisture in the gastrointestinal tract to liberate phosphine gas, which is the lethal agent. Cholecalciferol, also known as Vitamin D_3, stimulates the mobilization of calcium from the bone matrix into blood plasma, resulting in death from hypercalcemia in 3-4 days after ingestion of a lethal dose.

The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) requires that the benefits derived from the use of a pesticide be considered if adverse risks were assessed to be of concern. Thus, EPA must consider the benefits derived from the nine rodenticide products being evaluated before arriving at a decision regarding appropriate mitigation measures. As a first step in the process of developing a benefits assessment that addresses the proposed mitigations, the Agency issued in 2004 a document entitled Analysis of Rodenticide Bait Use (U.S.EPA, 2004). That document provided an overview of the current use of rodenticide baits in the United States and discussed the role of rodents as disease vectors and the damage that they cause to man-made structures and agriculture.

Objectives

This document provides a brief overview of the proposed mitigations for rodenticide baits; a qualitative impact assessment to human health, companion animals, and wildlife; and an estimation of some of the costs to users associated with the mitigations, including a socio-economic equity assessment. Limitations and uncertainties inherent in the assessment are described.

SUMMARY OF PROPOSED MITIGATIONS

The Agency has recognized the potential for accidental children exposure to rodenticides. The American Association of Poison Control Centers (AAPCC) data show more than 12,000 reported exposures per year in children less than six years old. Approximately 3% of reported exposures result in medical symptoms associated with rodenticide exposure (skin irritation, nausea, delayed blood clotting). However, it is likely that the total of rodenticide exposure incidents is greater than the number of cases reported to the AAPCC. EPA estimates that 25% of actual exposures are reported.

Similarly, the Agency recognizes that exposure to second generation anticoagulant rodenticides, especially brodifacoum, poses primary and secondary poisoning risks to birds and wildlife. Primary risk arises from direct consumption of anticoagulant rodenticide bait, while secondary risk arises when predators or scavengers feed on prey that has ingested and accumulated anticoagulant rodenticide bait.

In order to significantly reduce the exposure from rodenticide baits to children, companion animals, and wildlife, and thus effectively decrease the number of poisoning incidents, the Agency is proposing to implement the following three mitigation actions:

- ***Restricted use classification for the second generation anticoagulants***

Under this action, second generation anticoagulants brodifacoum, bromadiolone, and difethialone would be classified as "Restricted Use." The "Restricted Use" classification restricts a product, or its uses, to use by a certified pesticide applicator or by a person under his or her direct supervision. Detailed information on the "Restricted Use" classification is provided in 40 CFR Subpart I, 152.160. This action would, therefore, remove second generation anticoagulant rodenticide baits from the consumers[1] market, making them solely available to professional pest control operators (PCOs), city health inspectors, and other certified applicators. PCOs already use bait stations for indoor uses when, in their judgment, safety considerations require it. The Agency anticipates that rodenticide bait manufacturers would replace second generation anticoagulant active ingredients in rodenticide baits currently available to homeowners with active ingredients not affected by this action. The Agency assumes that all active ingredients registered for commensal rodent control can provide effective rodent control.

- ***Refillable (bait blocks only) tamper-resistant bait stations for all consumer-use products with indoor uses***

This mitigation would require that all consumer-use rodenticide bait products for both indoor and outdoor use be available only in refillable, tamper-resistant bait stations containing only active ingredients formulated in paraffinized blocks. The purpose of requiring tamper-resistant bait stations is to increase protection of children and pets from accidental exposure to rodenticides. Only paraffinized blocks would be allowed in bait stations because, unlike loose bait formulations, blocks placed inside bait stations would remain inaccessible to children. Loose baits, on the other hand, cannot be secured inside bait stations and will easily spill out.

- ***Tamper-resistant bait stations for outdoor above-ground placements of second generation anticoagulants***

Refillable tamper-resistant bait stations (baited with bait blocks) would be required for outdoor above-ground placements of second generation anticoagulant baits used by PCOs and other certified operators.

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[1] Refers to products available to the general public. In these document, the terms "consumer" or "consumer products" are used interchangeably with "homeowner" or "homeowner products."

CHARACTERISTICS OF RODENT PROBLEMS IN THE UNITED STATES

The American Housing Survey (AHS) is conducted every other year by the US Census Bureau to obtain housing statistics for the Department of Housing and Urban Development. The 2003 national survey is based on a sample of over 61,000 interviews. The survey collected information on a number of parameters on the type of dwelling and characteristics of the householders. Documentation of the survey includes a discussion of sampling and non-sampling errors in the survey (U.S. Census Bureau, 2004).

The survey includes three questions about the presence of rodents in the dwelling during the last three months. Based on the survey responses (Tables 1 and 2), the following observations may be made:

- Rodents are present in all types of dwellings, with the highest incidence in manufactured / mobile homes
- Most people can distinguish between the more common types of rodents (i.e., rats vs. mice vs. unidentified rodent)
- Mice are much more common than are rats
- Rats are more common in urban areas than in rural areas
- Mice are more common in rural areas than in urban areas.

Table 1. Characteristics of Occupied US Housing Units by Dwelling Type[1].

Characteristic	Total Units	Detached Units	Attached Units	Multiunit	Manufactured/ Mobile Home
Total	105,842	67,753	6,272	24,963	6,854
Median Household Income	$41,775	$52,171	$41,375	$27,750	$27,885
Below poverty level (Percent of Total)	13,960 (13.2%)	6,351 (9.4%)	857 (13.7%)	5,464 (21.9%)	1,288 (18.8%)
Signs of rats in last 3 months (Percent of Total)	829 (0.8%)	464 (0.7%)	53 (0.8%)	234 (0.9%)	78 (1.1%)
Signs of mice in last 3 months (Percent of Total)	6,304 (6.0%)	3,852 (5.7%)	365 (5.8%)	1,460 (5.8%)	628 (9.2%)
Signs of rodents; not sure which kind in last 3 months (Percent of Total)	345 (0.3%)	212 (0.3%)	20 (0.3%)	89 (0.4%)	24 (0.3%)

[1] Housing units are in thousands. Data are from American Housing Survey for the United States in 2003.

Table 2. Characteristics of Occupied US Housing Units by Ethnicity, Elderly, Poverty Level, Urban / Rural Location, and Dwelling Type[1].

Characteristic of Occupied Units	Total Units	Black alone	Hispanic	Elderly	Below Poverty Level	Urban	Rural
Total	105,842	13,004	11,038	21,627	13,960	78,369	27,474
Signs of rats in last 3 months (Percent of Total)	829 (0.8%)	185 (1.4%)	228 (2.1%)	123 (0.6%)	223 (1.6%)	700 (0.9%)	129 (0.5%)
Signs of mice in last 3 months (Percent of Total)	6,304 (6.0%)	1,179 (9.1%)	846 (7.7%)	949 (4.4%)	1,256 (9.0%)	3,829 (4.9%)	2,475 (9.0%)
Signs of rodents, not sure which kind in last 3 months (Percent of Total)	345 (0.3%)	73 (0.6%)	64 (0.6%)	38 (0.2%)	84 (0.6%)	255 (0.3%)	90 (0.3%)
Median Household Income	$41,775	$28,620	$33,259	$22,890			
Detached Units	67,753	6,104	5,511	14,961			
Attached Units	6,272	1,220	717	1,134			
Multiunit	24,963	5,013	4,364	4,046			
Manufactured/Mobile Home	6,854	667	447	1,487			

[1] Housing units are in thousands. Data are from American Housing Survey for the United States in 2003.

IMPACT ASSESSMENT OF PROPOSED MITIGATIONS

The Biological and Economic Analysis Division (BEAD)'s impact assessment contains three components: 1) benefits to human health, including human incidents, rodent-vectored diseases, and rat bites; 2) benefits to companion animals and wildlife; and 3) potential cost impacts including a socio-economic equity assessment. Due to the lack of the data necessary for valuing human health benefits and ecological benefits associated with the proposed mitigation, BEAD presents reported health and ecological incidents data and provides qualitative discussions on human health benefits and ecological benefits. Potential cost increases to a household are examined for each rodent control option available under proposed mitigation. Finally, the potential cost increases for each rodent control option is compared to the poverty threshold level for a 3-member household ($15,000 per year) to assess the likely financial impact of the proposed mitigations to a low-income household.

Benefits – Human Health

Human Incidents

The Toxic Exposure Surveillance System (TESS) of the American Association of Poison Control Centers (AAPCC) contains an estimated 98.8% of all rodenticide exposures reported to the poison control centers in the United States since 1983. Toxicology specialists at more than 60 poison control centers report incident data during their consultation with callers and collect detailed data on patient outcomes. Summary reports are published annually (Watson, et al., 2003, 2004, 2005).

The reported incident cases may only account for a quarter of the total cases that occur, especially those requiring inpatient or outpatient treatment. Chafee-Bahamon, et al. (1983) found that only 24% of 19,544 inpatient or outpatient cases in Massachusetts in 1979 were referred to the State's poison control center. Harchelroad, et al. (1990) also found that 26% of identified 470 toxic exposures in Pennsylvania were referred to the local poison control center in 1988. Although important, chronic health effects and cancer incidence due to pesticide uses were not included into the TESS. Also excluded were the heath effects that might be caused by environmental degradation (e.g., drinking water contamination) by pesticides. Therefore, it is likely that the total pesticide exposure incidents are greater than the number of cases actually reported to the Poison Control Centers.

The 3-year averages (2002-2004) of the cases of unintentional illnesses are presented in Table 3. For each of the identified rodenticide baits, this table reports the number of total exposure cases, the number of exposures to children less than 6 years of age, the number of cases seen in a health care facility, and the number of cases by reported outcomes (when known). These outcomes are as follows:

- **No effect:** Patient reported an exposure but did not developed signs or symptoms.
- **Minor effect:** Patient developed some signs or symptoms as a result of the exposure but the effects were minimally bothersome and generally resolved with no permanent disability or disfigurement.
- **Moderate effect:** Patient exhibited signs or symptoms as a result of the exposure that were more pronounced, more prolonged, or more of a systemic nature than minor symptoms. Patients usually received some form of treatment.
- **Major effect:** Patient exhibited signs or symptoms as a result of the exposure that were life-threatening or resulted in significant residual disability or disfigurement.
- **Death:** Patient died as a result of the exposure.

Table 3: The annual number of cases of incidents reported to the American Poison Control Centers (3-yr average - 2002 to 2004).

Category		Annual Cases (3-yr Average)				
		1st Generation Anticoagulants	2nd Generation Anticoagulants	Bromethalin	Cholecalciferol	Total
Total Exposures		380	16,545	538	18	17,481
Age < 6 yrs		320	14,684	435	16	15,455
Treated in Health Care Facility		108	4,840	170	6	5,124
Outcomes	No Effect	152	5,390	197	8	5,747
	Minor	5.7	235	13	7.7	261
	Moderate	3.3	110	6.3	0.3	120
	Major	0.3	31	1	0.3	33
	Death*	0	0	0	0	0

Source: Watson, et al., 2003, 2004, 2005.
*Approximately 2 annual intentional or malicious deaths are excluded from table.

Table 3 clearly shows that most reported cases (over 80 percent) occur in children less than 6 years of age. About 30 percent of the reported cased are treated in a health care facility. Typically, outcomes are known for less than half of the total exposures. For the known cases, No-Effect outcomes account for more than 93 percent. These no-effect cases theoretically would not result in any medical cost, but the TESS data show that 23% of the no-effect cases incurred medical costs for health facility visits. In addition, there are likely to be costs associated with lost productivity for the time and anxiety associated with a call to a poison control center.

Valuation of Human Health Effects

The health benefit associated with reduced illnesses and deaths can be measured by multiplying the reduced number of illnesses and deaths expected due to the proposed mitigation actions by the unit values of illness and death. The unit value of illness is estimated as the sum of the cost for outpatient visits, inpatient hospitalization stays, and lost wages. The outpatient cost and inpatient hospitalization cost are the price that the patient pays to the provider before it is reimbursed or paid by the insurance company. For example, the unit cost of respiratory-related hospital admissions of $6,900 was used in the cost-benefit analysis of the Clean Air Act Amendments by the Office of Air and Radiation (U.S. EPA, Office of Air and Radiation, 1999). However, inpatient hospitalization cost may apply only to major-effect cases which often require inpatient hospital stays. Based on the TESS, the average duration of illness ranged from 0.25 day for a minor-effect case to 1.9 days for a major-effect case.

The health benefit associated with avoided deaths can be based on the "value of a statistical life" (VSL) approach. EPA's Office of Air and Radiation's (OAR) work on the value of a statistical life has been widely cited throughout the Agency. For more information see Kochi et al. (2001). The estimated VSL was calculated to be $6.42 million in 2005 dollars. The U.S. EPA uses the value of VSL to express the benefits of mortality risk reductions in monetary terms for use in benefit cost analyses of its rules

and regulations. EPA has used the same central default value in its primary analyses since 1999 when the Agency updated its Guidelines for Preparing Economic Analyses (2000). Reductions in mortality risk constitute the largest quantifiable benefits category of many of EPA's rules and regulations.

BEAD did not monetize the potential health effects associated with proposed mitigation actions because the number and severity of illnesses that may be reduced by the mitigation actions cannot be accurately predicted. However, it is expected that the proposed mitigation actions would decrease the severity of illnesses for each outcome category, thus providing more protection to public health.

As previously discussed, the aim of the proposed mitigations is to reduce exposure of children and wildlife to second generation anticoagulant rodenticides. An added benefit of this action is to provide similar protection to pets. As previously stated, second generation anticoagulants are responsible for most accidental exposure to children and wildlife. Classifying second generation anticoagulant rodenticide baits as restricted use pesticides is expected to result in a net decrease in the use of these chemicals in homes. This, in turn, should lead to a decrease in toxicant exposure to children and pets. While second generation rodenticide baits will still be available for use in urban areas, their use would be limited to applications by certified pest control professionals (PCOs). The Agency assumes that due to their specialized training, experience, and liability, PCOs can be expected to use rodenticide baits safely and correctly. Furthermore, requiring that all rodenticide baits be available only in pre-baited, re-usable, tamper resistant bait stations of an approved design would make it difficult for children and pets to be accidentally exposed to baits, which would further decrease the number of accidental poisonings. Finally, eliminating the use of loose bait for use in bait stations would ensure that there is no spillage of baits out of bait stations, thus eliminating this potential source of poisoning for children and pets. Thus, the combined effect of restricting the use of second generation anticoagulant rodenticides, requiring that general use rodenticides are available for use to homeowners only in tamper-proof bait stations, and allowing only bait blocks to be used in bait stations would result in a decrease in the number of rodenticide poisonings.

Rodent-borne Diseases

The role of rodents as potential vectors for numerous diseases of public health concern was discussed in U.S. EPA's Analysis of Rodenticide Bait Use (2004). The Agency anticipates that the rodent control options available to households will not be impaired. If second generation anticoagulants are no longer available for use in consumer products , rodenticide bait manufacturers will likely replace them with first generation anticoagulant and non-anticoagulant active ingredients. Homeowners will continue to have access to rodenticide baits (in bait stations) and nonchemical rodent control measures, such as snap traps, while currently registered second generation anticoagulants will remain available to PCOs, public health personnel, and other certified applicators. Therefore, the proposed mitigations are not expected to adversely affect the risk to humans from rodent-borne diseases.

Food-Handling Establishments

Commensal rodents may contaminate foods and surfaces of equipment and utensils with their feces and urine. Commensal rats and mice that have been exposed to *Salmonella* bacteria in sewers or garbage may carry this pathogen in their gastrointestinal tract. Infected rodents coming in contact with stored food, kitchenware, or food preparation surfaces may readily contaminate them with their droppings. The contaminated food or surfaces can then become a source of *Salmonella* food poisoning for humans. Another bacterial disease transmitted by rodents is leptospirosis. This disease, characterized by symptoms ranging from those associated with the common cold to kidney damage and liver failure, can be contracted by handling contaminated items or from exposure to contaminated water (Blindauer, 1999).

The primary target pests for food-handling establishments, such as restaurants (full-service and fast-food), institutional facilities (schools and prisons), food processors, and food warehouses, are flies, cockroaches, rodents and ants. These pests account for more than 80% of the pesticide product sales to food handling establishments. Less than 15% of the total pesticide product sales to food handling establishments are for the control of rodents. U.S. food handling establishments total approximately 630,000. Restaurants account for approximately 65% of food handling establishments, followed by institutional facilities (22%), food processors (7%), and food warehouses and other establishments (5%). More than 90% of food-handling establishments rely on PCOs for pesticide treatments. Rodent bait stations and glue boards are the most popular devices for both monitoring and controlling rodents for food-handling establishments. Rodent control product sales are estimated at more than $10 million per year for food-handling establishments. (EPA proprietary data, 2005)

Restaurants: Rodent bait stations are the most common pest trapping and monitoring devices used in restaurants. Just over 50% of their use is for rodent monitoring purposes, and the remainder is for rodent control. These devices are checked monthly by PCOs, and the PCO typically makes the treatment decision. Bait stations are usually placed in storage/warehouse areas, and may also be placed in food preparation serving, and receiving areas, outside buildings, and in restrooms and other areas. (EPA proprietary data, 2005)

Institutional facilities: Schools account for more than 90% of institutional facilities. Sports arenas, prisons, and government buildings make up the remaining 10% of institutional facilities. More than 30% of institutional facilities are found in the South, and the primary target pests are cockroaches, ants, rodents, and flies. Less than 20% of pesticide applications made at institutional facilities are for the control of rodents. Rodent bait stations are the leading means used to control rodents. Glue boards are also commonly used. Bait stations and glue boards are usually placed in storage/warehouse areas, and may also be placed in food preparation, serving and receiving areas, outside buildings, and in restrooms and other areas. (EPA proprietary data, 2005)

Food processors: Processed foods include baked goods, canned goods, processed goods, meats, spices, beverages, and edible pharmaceutical coatings. The two key pests of food processing plants are flies and rodents. More than 40% of applications made for pest control are targeted toward rodents. Rodent bait stations and glue boards are the most commonly used pest trapping and monitoring devices in food processing plants. They are most often placed in storage and warehouse areas, receiving areas, and food preparation areas. (EPA proprietary data, 2005)

Food warehouses: This group of facilities includes packaged food warehouses, distribution centers, and food ingredient warehouses. The primary pests targeted in food warehouses are rodents and flies. Rodents are targeted by nearly 50% of applicators treating for pests in food warehouses. Rodent bait stations and glue boards are the most used trapping and monitoring devices used in food warehouses. These devices are usually placed in storage/warehouse areas, and may also be placed in food preparation, serving and receiving areas, outside buildings, and in restrooms and other areas. (EPA proprietary data, 2005)

First generation anticoagulants are still available, along with other nonchemical rodent control measures, for use by non-professional applicators in and around food-handling establishments for the control of rodents, and more than 90% of food-handling establishments depend on PCOs for rodent control. Since the proposed mitigations will not affect the availability of currently registered rodenticides to PCOs, rodent control in and around food-handling establishments are not expected to be adversely affected by the proposed actions.

Rat Bites

Under heavy infestation conditions, rats are known to bite humans, especially those who are unable to move or to protect themselves, such as infants and incapacitated adults. Based on a review of available annual reports from nine U.S. cities, Clinton (1969) estimated that during 1957 - 1967 there were approximately 10 bites (range: 2.4 - 15.4) per 100,000 population in major U.S. urban centers, representing an annual total of 14,000 bites based on an estimated population of 140 million city dwellers. These same estimates have also been attributed to Scott (1965) by Pratt et al. (1976). Most such bites occurred in the more economically depressed city neighborhoods, where only about one-third of incidents were reported, and nearly all bites were inflicted by the Norway rat.

During 1955 – 1963, between 500 and 750 rat bites were reported annually to the New York City's Department of Health, or about 8.3 – 12.5 bites per 100,000 population, based on a total population of 6 million (Clinton, 1969). In 1974 and 1978, the number of reported bites in New York City had decreased to 226 and 162, respectively, or about two per 100,000 people (Coombe and Marr, 1980).

As previously discussed, consumers will still be able to buy products containing active ingredients other than second generation anticoagulants, and second generation anticoagulants will still be available to PCOs, public health personnel, and other certified applicators. Thus, consumers would continue to have multiple options for rodent control, including purchasing bait stations, snap traps, and glue traps; contracting a pest control firm; and, where feasible, requesting assistance from their municipal government. Families living in apartment buildings generally rely on the building owner or manager for dealing with rodent problems inside the apartment or building. Since a wide-range of rodent control options would continue to be available, no adverse impact on the frequency of rat bites to humans is expected as a result of the proposed mitigation.

Benefits – Companion Animals and Environmental Resources

Companion Animals Incidents

The American Society for Prevention of Cruelty to Animals (ASPCA) Poison Control Center has some exposure incident information for pets, mostly dogs. The Center reports 2334 cases involving potential exposure of 2685 animals from November 01, 2001 to June 16, 2003 (Erickson and Urban, 2004). Table 4 presents the exposure incidents to pets. More than 80% of such incidents are due to exposure to 2nd generation anticoagulants.

Table 4. Number of reported rodenticide incidents to pets from November 02, 2001 to June 16, 2003.

Rodenticide		Number of Incidents
Second-generation anticoagulants	Brodifacoum	1161
	Difethialone	0
	Bromadiolone	511
First-generation anticoagulants	Chlorophacinone	42
	Diphacinone	206
	Warfarin	42
Non-anticoagulants	Bromethalin	66
	Zinc Phosphide	0
	Cholecalciferol	34

Source: Erickson and Urban, 2004

Wildlife Incidents

Incident reports submitted to the Agency also indicate that wild birds and nontarget mammals are being exposed to rodenticides, especially brodifacoum. More than 80% of incidents are due to exposure to 2nd generation anticoagulants. EPA's Ecological Incidents Information System (EIIS) contains information on more than 400 incidents in which one or more of the rodenticides was detected in birds or nontarget mammals. Table 5 presents comparative number of reported rodenticide nontarget incidents from approximately the mid-1990s to 2004. Most of the incidents in the EIIS data base occurred in New York and California.

Over 400 wildlife incident reports involving rodenticides were recorded mainly in California and New York. Most such incidents are due to exposure to second generation anticoagulants, especially brodifacoum, in urban areas (Erickson and Urban, 2004; U.S. EPA, 2006). Reported incidents are presumed to account for only a fraction of occurrence and involve at least one endangered mammalian species, the San Joaquin kit fox. There was a wide diversity of non-target animals exposed to rodenticides, including mountain lions, bobcats, coyotes, foxes, tree squirrels, red-tailed hawks, and great horned owls. Approximately 50% of the incidents are classified by EPA as "highly probable" that an anticoagulant rodenticide caused the mortality, based on liver analysis and/or necropsy findings. Brodifacoum accounts for 70-75% of rodenticide incidents. Anticoagulant residues were present in 27 of 32 endangered kit fox carcasses. Brodifacoum was detected in all 27 carcasses, although many had residues of several different anticoagulants (Erickson and Urban, 2004; U.S. EPA, 2006).

While all anticoagulants act by binding to vitamin K epoxide reductase (VKOR), second generation anticoagulants, such as brodifacoum, bind strongly to VKOR and may persist for at least six months in organs and tissues containing this enzyme, such as liver, kidney, and pancreas (Eason et al., 2001). Half lives of second generation anticoagulant brodifacoum and first generation anticoagulants warfarin and diphacinone in laboratory rat livers have been reported to be 113.5, 26.2, and 2 days, respectively (Fisher et al., 2003). The risk of secondary poisoning to scavengers and predators feeding on dead on living target mammals that have ingested second generation anticoagulant rodenticides is greater than when the target mammals have been exposed to first generation anticoagulants. Although a single feeding on bait containing a second generation anticoagulant may be sufficient to kill a rodent, death may not occur until four to eight days later. However, even after having consumed a fatal dose, a rodent may continue to feed on the bait for several days, thus continuing to accumulate the toxicant. By the time the rodent dies, it may have consumed and accumulated enough of the active ingredient to cause illness or death to any small carnivore or scavenger, mammal or bird, that feeds on its carcass (Erickson and Urban, 2004; EPA, 2006).

Rodents must feed several times on baits containing first generation anticoagulants, usually over a 4-5 day period, before ingesting a fatal dose. If feeding is interrupted, the rodent may survive. Unlike second generation anticoagulants, first generation anticoagulants do not readily accumulate in organs such as liver and pancreas, and are therefore rapidly eliminated (Eason et al., 2001). Thus, target rodents feeding on first generation anticoagulants are less likely than those feeding on second generation anticoagulants to accumulate the toxicants at levels that will pose a risk of secondary poisoning to predators or scavengers.

The proposed mitigation would protect wildlife in at least two ways. First, classifying second generation anticoagulants as "Restricted Use" would significantly decrease the overall use of products containing brodifacoum, bromadiolone, and difethialone. These active ingredients would, in probability, be replaced with first generation anticoagulants or non-anticoagulants, both of which pose significantly less risk to wildlife. Second,

requiring tamper-resistant bait stations for all outdoor above ground uses of second generation anticoagulants would prevent wildlife from directly ingesting rodenticide bait, thus reducing the risk of primary poisoning to birds and nontarget mammals. Although these mitigations will not entirely eliminate the risk of secondary poisoning for wildlife, their exposure to second generation anticoagulants would be significantly reduced.

Table 5. Comparative Number of Reported Rodenticide Nontarget Incidents From the mid-1990s to 2004.

Rodenticide		Number of Incidents
Second generation anticoagulants	Brodifacoum	244
	Difethialone	1
	Bromadiolone	39
First generation anticoagulants	Chlorophacinone	13
	Diphacinone	20
	Warfarin	4
Non anticoagulants	Bromethalin	0
	Zinc Phosphide	25
	Cholecalciferol	0

Source: U.S. EPA (2004)
*Nontarget species include owls, diurnal raptors, corvids, other birds, wild canids, wild felids, other carnivores, deer, rodents/rabbit, and opossum.

Valuation of Ecological Effects

There are several economic methods that can be used to place a value on ecosystem services. These methods, as described below, base economic values on various aspects of consumer and producer behaviors, and draw on stated individual preferences.

- *Household Production Function Methods* model consumer behavior based on the assumption that ecosystem services can be substitutes for or complementary to a marketed commodity. Travel-cost models infer the value of an ecosystem according to the travel time and costs needed to visit the site.

- *Production Function Methods* model the behavior of products and their response to changes in environmental quality that influence production. These methods have been applied to explore the habitat-fishery, water quality-fishery linkages, and erosion control and storm protection.

- *Stated Preference (Contingent-valuation) Methods* are commonly used to measure the value people place on a particular environmental item. Examples include how much people would pay annually to obtain swimmable, fishable, and drinkable freshwater.

- *Benefit Transfer Methods* estimate the value of an ecosystem based on existing studies of a roughly similar ecosystem. However, benefit transfer methods should be considered second best to careful analysis of the specific ecosystem in question.

Assigning value to ecological effects is subject to many uncertainties and a wide margin of variation. A few available ecological evaluation studies that estimated ecological benefits of environmental regulations are often case-specific and thus, their benefit estimates can not be generalized for other studies. However, a study by the U.S. Fish and Wildlife Service in 1996 could provide a rough approximation to the potential magnitude of the ecological benefits of avoided exposure incidents to pets and non-target species. The study estimated net economic values for deer hunting, and primary non-residential wildlife watching based on contingent-valuation methods from the 1996 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation. For example, the net economic value per year per participant for wildlife watching ranges from $18 to $696 (U.S. Fish & Wildlife Service, 1996).

BEAD did not monetize the potential ecological effects associated with proposed mitigation actions because 1) the number of ecological incidents that may be reduced by the mitigation actions cannot be determined and 2) BEAD has identified no study that measured valuation of ecological effects useful for the benefit assessment on rodenticides. However, the proposed mitigation actions are expected to decrease the number of incidents on birds, non-target mammals and pets.

Costs of Proposed Mitigations

Rodent Control

The data that are available for residential rodenticides provide limited information on two broad markets for rodent control, the homeowner and the pest control operator (PCO) markets (EPA proprietary data, 2005). The homeowner market includes products purchased by homeowners to control rodents. The PCO market includes products purchased by PCOs to control rodents in residential settings. Rodenticide baits currently available for homeowners are most commonly used to kill commensal mice and rats in homes, yards, and outbuildings. Most such baits are now formulated with brodifacoum, a single-dose (first generation) anticoagulant that inhibits blood clotting to cause death from internal bleeding.

Based on EPA proprietary data (2005), the annual value of the homeowner market for rodenticides is estimated at about $100 million. The largest regional U.S. market is estimated to be the South (35%), followed by the Midwest (31%), the West (18%), and the Northeast (16%). More than 90% of the rodenticide market for the control of rodents is in the form of dry bait rodenticides. Of the dry bait rodenticides, bait packets are most popular and account for about 60% of the market for dry bait rodenticides. In addition to brodifacoum, other active ingredients used in this market include first generation anticoagulants chlorophacinone and diphacinone. D-Con® is the most widely used rodenticide bait product, accounting for nearly 80% of rodenticide sales to homeowners. D-Con® may contain brodifacoum or another active ingredient. Approximately 90% of rodenticide sales in the homeowner market are for the elimination of mice. (EPA proprietary data, 2005)

The estimated value of the market for rodent control products used by PCOs is more than $15 million annually. The largest regional market for professional rodent control is the South (40% to 45% of the total market), followed by the Midwest, the Northeast and the Western U.S. An estimated 75% to 80% of the market consists of rodenticide products, with the remaining 20% to 25% of the market in other methods of rodent control, such as glue and snap traps. An estimated 60% to 65% of professional rodent control is for mice, 35% to 40% is for rats, and 1% to 2% is for other rodents (e.g., gophers, squirrels, etc.). An estimated 60% of the PCO work to control rodents is residential and 40% is commercial. (EPA proprietary data, 2001)

As much as 80% of the rodenticide sales to PCOs are for products containing the active ingredients bromadiolone (an estimated 50% of the total rodenticide market) and brodifacoum (an estimated 30% of the total rodenticide market). The primary products containing bromadiolone are Contrac®, and Maki®, and for brodifacoum, the primary products include Talon®, Final®, and WeatherBlok®. Other rodenticides with estimated use include difethialone, diphacinone, chlorophacinone, zinc phosphide, bromethalin and cholecalciferol. (EPA proprietary data, 2001)

Consumers attempting to control rodent problems can fall into the following three groups:

- **Group 1:** Households that currently use methods other than rodenticide baits (such as snap traps and glue traps) to control rodents.

- **Group 2:** Households that currently use rodenticide baits available in the market to control rodents.

- **Group 3:** Households that currently hire PCOs to control rodents.

For the cost analysis, EPA assumes that consumers' selection of rodenticide baits is primarily driven by trade names and not by the active ingredients contained in the baits. EPA further assumes that the replacement of second generation anticoagulants with first generation anticoagulants will not significantly affect the homeowners' capability to control commensal rodents.

While the labels for second generation anticoagulant baits currently available to homeowners already recommend the use of bait stations to reduce children's exposure to the rodenticides, consumers generally do not use bait stations. Therefore, the cost estimates presented in this analysis might overestimate the incremental costs associated with the use of bait stations.

No cost impact is expected to the consumer group 1 because consumers in this group are not affected by the mitigation proposals. For the consumer group 2, the potential incremental costs associated with the mitigation proposals would be:

- The cost of single-use or refillable tamper-resistant bait stations if they decide to continue to use rodenticides.

- The cost of hiring PCOs to control rodents less the cost of rodenticides currently available at the market if they decide to hire PCOs. However, few households in this group are expected to hire PCOs because of the relatively high cost associated with such pest control services.

- The difference of the cost of rodenticide bait alternatives, such as snap or glue traps, and the cost of rodenticides currently available in the market if they decide to use non-rodenticides.

For consumer group 3, no cost increase is expected because it is assumed that they will continue to use PCO services. Table 6 shows the average, low, and high prices of rodent-control products. The prices were obtained from store visits in northern Virginia area and on-line search (see Appendix A for detailed information on prices of each rodent-control products). Prices of rodenticide bait range from $0.16 to $1.32 per oz. Prices for the bait stations for rat are higher than those for mice. The average price of bait station for rats is $11.31, while it is $2.47 for mice. For both snap and glue traps, prices are higher for rats because of the large size and strong materials necessary for rat control. Snap traps are generally more expensive than glue traps. However, snap traps can be reused.

Table 6. The prices of rodent-control products for mice and rats

Rodent-Control Product	# of Samples	Average Price	Low Price	High Price
	For Mice			
Snap trap	9	$1.39	$0.55	$2.48
Glue trap	6	$0.45	$0.32	$0.63
Bait station	6	$2.50	$1.68	$3.34
Rodenticide pellet/granular/bait block per oz	27	$0.60	$0.16	$1.32
PCO cost per service performed	2	$254.00*	$250.00	$258.00
	For Rats			
Snap trap	2	$2.81	$1.91	$4.98
Glue trap	4	$1.79	$1.08	$2.98
Bait station	7	$11.71	$6.92	$16.87
Rodenticide pellet/granular/bait block per oz	24	$0.60	$0.16	$1.32
PCO cost per service performed	3	$254.00*	$250.00	$258.00

Source: Prices and bait stations and rodenticides are obtained from store visits and prices of snap and glue traps are obtained from on-line sources (See Appendix A).
*Initial inspection and treatment plus 2nd treatment later if necessary

BEAD estimated the annual incremental cost for an average size single-family home for a single rodent infestation occurrence based on the following assumptions.

- BEAD assumed that 1 oz for dry bait rodenticide (pellet, granular, or bait block) is sufficient to provide initial control of one or two mice per placement, and 2 oz to control one or two rats per placement.

- BEAD assumed that a tamper-resistant bait station can be repeatedly used for up to 5 years.

- BEAD assumed that 1 to 4 bait stations (or 1 to 4 rodent traps) are needed to control mice or rats in the average size single-family home, depending on infestation level.

- BEAD assumed that all the rodent control options considered in this study are similarly efficacious in controlling mice or rats. One snap (or glue) trap is assumed to be, roughly, the equivalent of one bait station with bait blocks.

The result of this analysis is largely affected by the assumptions stated above, which may not represent the household's actual responses to the proposed mitigation actions. In addition, many other uncertainties that potentially affect the results are not addressed in this analysis. For example, BEAD cannot accurately predict the market situation for rodenticide products after the new regulation goes into effect. There are many uncertainties associated with the estimated figures and therefore, they are subject to a wide margin of variability. Table 7 shows the incremental costs per household for each rodent control option considered in this analysis.

Table 7: The incremental costs per household for each rodent control option

Rodent Control Options	Cost per Household		Incremental Cost[1]	
			For Mice	
	Low[3]	High[4]	Low	High
Current cost of rodenticide[2]	$0.60	$2.40		
Bait station plus bait block	$1.10	$12.41	$0.50 (83%)	$10.01 (417%)
Snap Trap	$0.28	$5.58	-$0.32 (-54%)	$3.18 (132%)
Glue Trap	$0.45	$1.81	-$0.15 (-24%)	-$0.59 (-24%)
PCO	$254.00	$254.00	$251.60 (10,480%)	$253.40 (42,233%)
			For Rats	
Current cost of pellet/granular	$1.20	$4.80		
Bait station plus bait block	$3.54	$51.64	$2.34 (195%)	$46.84 (976%)
Snap Trap	$0.56	$11.24	-$0.64 (-53%)	$6.44 (134%)
Glue Trap	$1.79	$7.18	$0.42 (50%)	$1.69 (50%)
PCO	$254.00	$254.00	$249.20 (5,192%)	$252.80(21,067%)

[1]Incremental costs are calculated as the cost of each rodent control option less the current cost of rodenticide.
[2]The current costs of rodenticide for controlling mice and rats are the costs of pellet/granular/bait block per 1 oz and 2 oz, respectively.
[3]Low cost represents the cost per household with 1 placement and when bait stations and snap traps are reusable for 5 years.
[4]High cost represents the cost per household with 4 placements and when bait stations and snap traps are not reused.

The current annual cost of mouse control per household using rodenticide baits ranges from $0.60 to $2.40, while it ranges from $1.20 to $4.80 for rats control in proportion to the number of placements in the house. With the proposed regulatory action, most households are expected to buy refillable tamper-resistant bait stations with bait blocks to control mice and rats. As a result, the incremental costs to a household per year were estimate at $0.50 to $10.01 for mice control and at $2.34 to $46.84 for rat control. This means households will need to increase their expenses on rodent control by 195% to 976%. The size of the incremental costs depends on the number of the placements of bait stations and their lifespan.

Households can also choose to use snap or glue traps to control mice or rats. In that case, the incremental costs for a household to control mice per year were estimated at -$0.32 to $3.18 for snap traps, and -$0.15 to -$0.59 for glue traps, respectively. The incremental costs for a household to control rats per year were at -$0.64 to $6.44 for snap traps, and $0.42 to $1.69 for glue traps, respectively.

The cost of hiring a PCO is much higher than other options. The average price of hiring a PCO to control mice or rats in an average single-family home is estimated at $254 per occurrence. This would result in a significant cost increase of $249.20 to $252.80 per infestation case per year. However, very few households are expected to choose this

option because of the availability of other cheaper options which are also effective in controlling mice and rats.

Socio-Economic Equity Assessment

The U.S. Census Bureau conducted the American Housing Survey to obtain up-to-date housing statistics in 2003. Census data show that the lower the household income level the greater the expectation of rodent problems. Eleven percent of households below the poverty-level[2] reported having seen rodent signs within last 3 months, while this figure is only 7% for all households in the United States (American Housing Survey for the United States, 2003).

BEAD assessed the incremental costs as a percentage of a household income at poverty level for a 3-member household. For a household with 3 members, the poverty threshold level is $15,000 for 2004 (U.S. Census Bureau, 2006). Table 8 shows the incremental cost of each rodent control option as a percentage of a household income at poverty level for a 3-member household. Only for the case that a low-income household will need to hire a PCO, will the cost exceed 1% of the $15,000 poverty threshold level. But very few low-income households are expected to hire PCOs instead of buying the bait stations or rodent traps in the market.

Table 8. Incremental cost to a low-income household with $15,000 annual income*.

Rodent Control Options	**Incremental Cost as a % of $15,000**	
	For Mice	
	Low	High
Bait station plus bait block	0.003% (=$0.49/$15,000)	0.066% (=$9.89/$15,000)
Snap Trap	-0.002% (=-$0.32/$15,000)	0.021% (=$3.18/$15,000)
Glue Trap	-0.001% (=$0.15/$15,000)	-0.004% (-$0.59/$15,000)
PCO	1.689% (=$251.60/$15,000)	1.677% (=$253.40/$15,000)
	For Rats	
Bait station plus bait block	0.015% (=$2.26/$15,000)	0.302% (=$45.23/$15,000)
Snap Trap	-0.004% (=-$0.64/$15,000)	0.043% (=$6.44/$15,000)
Glue Trap	0.004% ($0.59/$15,000)	0.016% ($2.38/$15,000)
PCO	1.685% ($249.20/$15,000)	1.661% ($252.80/$15,000)

*Source: U.S. Census Bureau, 2006

Low income consumers living in apartment buildings most likely rely on the building owner or manager for rodent control inside the apartment or building. In addition, most cities have the capacity to respond to some extent to rodent-related complaints by deploying inspectors who assess the severity of the reported problems and place bait stations as needed. According to the Illinois Department of Public Health (2005), a typical large U.S. city receives each year over 10,000 complaints related to rodent problems and performs tens of thousands of rodent control inspections and baiting

[2] Poverty threshold is the level of income below which one cannot afford to purchase all the resources one requires to live. The average size of a household is 3 people and about 10% of all households in the United States are below the poverty level (US Census Bureau, 2006).

services. In 1996 the New York City Department of Health's Pest Control Program received about 20,000 rodent-related complaints and performed about 24,000 inspections and 35,000 rodent extermination services. In 2003, this program received 21,000 complaints and performed 64,000 inspections and almost 75,000 extermination services (Frieden, 2003). Cities' health, sanitation, or equivalent departments generally perform rodent control activities in public areas, such as streets, alleys, parks, and sewers, but will not usually attempt to control rodents inside residences. Thus, rodent control inside dwellings will likely continue to be dealt with by occupants through the use of rodenticide baits (in bait stations), snap traps, or a combination of both baits and traps. Snap traps continue to represent a cheap and effective tool for controlling rodents.

UNCERTAINTIES

Resistance to First Generation Anticoagulant Rodenticides

As discussed previously, second generation anticoagulants, such as brodifacoum, are the active ingredients most commonly used in rodenticide products for the consumer market. If second generation anticoagulants become classified as "Restricted Use," first generation anticoagulants and non-anticoagulants will likely take their place.

Instances of commensal rodent resistance to warfarin have been reported for several European countries since 1958, and for several U.S. cities since 1971, suggesting that this problem is widespread (Frantz and Padula, 1980; Jackson and Ashton, 1986; Frantz, 1998; Hans-Joachim et al., 2005). On the other hand, data from at least one study suggest that, if correctly managed, warfarin may still have a role in the U.S. as a rodent management tool (Frantz and Madigan, 1998). Resistance to warfarin developed during a period when commensal rodent control relied almost exclusively on the use of this toxicant. The use of baits containing inadequate warfarin levels, coupled with ineffective baiting programs, may have further contributed to the development of resistance in at least in some areas (Jackson and Ashton, 1986). The Agency believes that existing levels of rodent resistance to first generation anticoagulants will not be aggravated as a result of the proposed regulatory actions because PCOs and other certified applicators will continue to rely primarily on second generation anticoagulants, such as brodifacoum. Kaukeinen et al. (2000), citing an earlier report by Mix (1986), estimated that in 2000 over 98% of professional applicators in the U.S. used brodifacoum and/or bromadiolone products (both second generation anticoagulants) for commensal rodent control. U.S. EPA proprietary data (2005) indicates that as much as 80% of the rodenticide sales to professional applicators are of products containing the active ingredients bromadiolone and brodifacoum. The demonstrated preferential use of second generation anticoagulant rodenticide baits by pest control professionals would ensure that commensal rodents in most locations are exposed to both first and second generation anticoagulants, as well as to non-anticoagulants.

Moreover, rodenticide baits are one of several complementary tools available for managing rodents in urban areas (Frantz and Davis, 1991; Illinois Department of Public Health, 2005). Successful rodent management programs in urban areas are seldom based

on the use of rodenticide baits alone, although inspection and baiting may often be the only service provided by some municipal governments when responding to rodent related-complaints. Baits may remove individuals from the target population, but by themselves will not permanently control commensal rodents as long as there are available sources of food (usually garbage), water, and shelter. Norway rat control in cities can be challenging, especially in the more economically depressed areas, where poor waste management and less than optimum housing conditions are favorable to rodent survival. Long-term rodent control in urban areas is best achieved under an integrated pest management (IPM) approach, using multiple and complementary rodent control available measures, both nonchemical and chemical (Frantz and Davis, 1991; Frantz, 1996; U.S. EPA, 2004).

In general, the presence of competing, alternative food sources, such as unprotected food in homes or exposed garbage, is known to interfere with the performance of poisoned baits. Multiple-dose (first generation) anticoagulant baits are especially vulnerable to situations where the availability of alternative food sources make it less likely that a rodent will return to feed on baits for several days in succession until it ingests a lethal dose. Under such conditions, some rodents are likely to ignore the bait, while others may feed on it once and never return for a second feeding. Also, since first generation anticoagulants are excreted soon after ingestion, rodents feeding infrequently on the bait, i.e. those skipping one or more days in between feedings, will fail to ingest a lethal dose (EPA, 2004). Therefore, depriving rodents of alternative food sources, whether garbage or unprotected food supplies, is a necessary component of any well-designed rodent control program.

Incident, Housing, and Rodenticide Prices Data

All data sources have associated uncertainties. Information included herein on U.S. housing and on the human exposure and incidents are based on data from third parties. Please refer back to the original sources for a discussion of the survey design, sampling and non-sampling errors, and uncertainties in the databases (U.S. Census Bureau, 2004; Watson, et al., 2003, 2004, 2005). The data on rodenticide bait prices is limited to that from easily available on-line vendors and local retailers. Prices could vary by location.

Effectiveness of Snap Traps Vs. Anticoagulant Rodenticide Baits

The time required for controlling a light mouse infestation, using either snap traps or rodenticide bait stations, probably depends on the number of traps or bait stations placed in the infested area. Corrigan (2006) suggests that for minor mouse infestations (1-2 mice per infested area) six or eight traps can eliminate the infestation in two nights of trapping, whereas only one or two bait stations would suffice for the average residential mouse infestation. Although both traps and rodenticide baits will cause rodent mortality, these two distinct rodent control measures are not readily comparable. For the purpose of this analysis, however, the Agency assumes that one snap trap is the equivalent of one rodenticide bait station in its capacity to kill a rodent. This assumption does not consider the time needed to totally eliminate the infestation .

CONCLUSIONS

Most poisoning incidents involving exposure to second generation anticoagulants occur in children less than six years old, companion animals, birds, and nontarget mammals. To address these problems, the Agency proposes to require that: 1) second generation anticoagulants be classified as "Restricted Use," 2) rodenticide baits be available to homeowners only in pre-baited (with bait blocks only), tamper-resistant bait stations; and 3) above-ground placements of second generation anticoagulant rodenticide baits be only in tamper-resistant bait stations. The proposed mitigations are designed to provide added safety and protection from accidental exposure to children, companion animals, birds, and nontarget mammals.

We evaluated the impacts of the proposed mitigations on rodent control and find that they will not impose constraints on rodent control programs and activities. Homeowners will still be able to control rodents either through PCOs, by means of baits (in bait stations), or by means of cost-effective alternative methods, such as snap traps.

The proposed mitigation requiring that second generation anticoagulants be classified as "Restricted Use" should not have an adverse impact on homeowners, because they will still be able to purchase baits (in bait stations) containing first generation anticoagulant and non-anticoagulant active ingredients.

The proposed mitigation requiring that rodenticide baits be available to homeowners only in pre-baited (with bait blocks only), tamper-resistant bait stations will result in an increased cost for rodent control for those households that choose to use rodenticide baits. Homeowners that are unable or unwilling to buy rodenticide baits will still be able to use alternatives such as snap traps.

The proposed mitigation requiring that above-ground placements of second generation anticoagulant rodenticide baits be only in tamper-resistant bait stations should not result in an increased cost for rodent control for PCOs since label language already requires the use of bait stations for outdoor uses of rodenticide baits.

This assessment is based on numerous assumptions and is subject to the uncertainties discussed above.

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APPENDICES

Appendix A. Prices of rodent control products.

Prices of snap trap for mice		
Trap	**Price as Reported**	**Cost per Unit**
Clean Catch Mouse Traps	$15.90 for 12 units	$1.33
	$25.90 for 36 units	$0.72
Victor Snap Traps	$2.03 for 2 units	$1.02
	$9.75 for 12 units	$0.81
	$39.75 for 72 units	$0.55
Victor Quick Kill Mice Traps	$3.95 for 2 units	$1.97
	$14.90 for 6 units	$2.48
	$25.99 for 12 units	$2.17
	$36.00 for 24 units	$1.50
Average		**$1.39**

Source: internet search on May – June, 2006

Prices of Snap trap for Rats		
Trap	**Price as Reported**	**Cost per Unit**
Victor Rat Traps Pro	$13.99 for 6 units	$2.33
	$24.25 for 12 units	$2.02
Victor Rat Snap Traps	$22.95 for 12 units	$1.91
Trapper T-Rex Rat Trap	$14.95 for 3 traps	$4.98
Average		**$2.81**

Source: internet search on May – June, 2006

Prices of glue trap for mice		
Glue Traps	**Price as Reported**	**Cost per Unit**
Bell Trapper Max Glue Boards	$12.50 for 20 units	$0.63
Bell Glue Board for Mice	$29.90 for 72 units	$0.42
	$115.75 for 360 units	$0.32
Protecta MC Glue Boards	$19.90 for 48 units	$0.41
Glue Boards for Tin Cat	$28.80 for 72 units	$0.40
Corner Cat Glue Boards	$19.50 for 36 units	$0.54
Average		**$0.45**

Source: internet search on May – June, 2006

Prices of glue trap for rats		
Glue Traps	**Price as Reported**	**Cost per Unit**
Rat Glue Trays	$4.00 for 2 units	$2.00
JT Eaton Stick-EM Rat Glue Traps	$5.95 for 2 units	$2.98
Rx-Wholesale Glue Rat Traps Medium size	$12.95 for 12 units	$1.08
Rx-Wholesale Glue Rat Traps Large size	$21.95 for 12 units	$1.83
Catchmaster 48R Rat Size Glue Traps	$51.95 for 48 units	$1.08
Average		**$1.79**

Source: internet search on May – June, 2006

Prices of PCO*	
Orkins	$250
OrlandoRats.com	$258
Average	$254

Source: internet search on May 23, 2006

*Initial inspection and treatment plus 2nd treatment later if necessary

Costs of Rodenticide Baits					
Name	**Amount (# units*size)**	**Form**	**Price Range (Average) ($)**	**Unit Price** ($ per oz)**	**Source**
Kaput Rodenticide (Warfarin)	10 lbs (105 *1.5 oz)	Block / bar	$31.67	$0.20	Online retailer
Kaput Rodenticide (Warfarin)	5 lbs (75*1.1 oz)	Place pack / pellet	$18.47	$0.31	Online retailer
Havoc Rodenticide (Brodifacoum)	1.9 oz (2*0.89 oz)	Place pack / pellet	$1.39	$0.73	Retail stores, Warrenton and Manassas, VA
d-Con Mouse Prufe II (Brodifacoum)	1.5 oz (1*1.5 oz)	Place pack / pellet	$1.47 -- $1.99 ($1.65)	$1.10	Retail stores, Warrenton and Manassas, VA
d-Con Mouse Prufe II (Brodifacoum)	6 oz (4*1.5 oz)	Place pack / pellet	$4.92 – $4.99 ($4.95)	$0.83	Retail stores, Warrenton and Manassas, VA
d-Con Pellets Generation II (Brodifacoum)	12 oz (4*3 oz)	Place pack / pellet	$4.47	$0.37	Retail stores, Warrenton and Manassas, VA
d-Con Ready Mixed Generation II (Brodifacoum)	12 oz (4*3 oz)	Place pack / pellet	$4.47-- $5.00 ($4.79)	$0.40	Retail stores, Warrenton and Manassas, VA
Just One Bite Bar (Bromadiolone)	16 oz (8*2 oz)	Block / bar	$5.59	$0.35	Retail stores, Warrenton and Manassas, VA
Victor Rat and Mouse Blocks (Bromadiolone)	6 oz (6*1oz)	Block / bar	$2.77 - $3.99 ($3.38)	$0.56	Retail stores, Warrenton and Manassas, VA
d-Con Mini Blocks (Difethialone)	5.6 oz (8*0.71 oz)	Block / bar	$4.99 - $5.49 ($5.32)	$0.95	Retail stores, Warrenton and Manassas, VA
Just One Bite Farnam Rat and Mouse Bait Packs (Bromadiolone)	4.5 oz (3*1.5 oz)	Place pack / pellet	$2.79	$0.62	Retail stores, Warrenton and Manassas, VA
Just One Bite Farnam Rat and Mouse Bait Packs (Bromadiolone)	15 oz	Place pack / pellet	$6.78	$0.45	Retail stores, Warrenton and Manassas, VA
Real Kill Place Packs (Bromethalin)	6 oz (8*0.75 oz)	Place pack / pellet	$4.78	$0.79	Retail stores, Warrenton and Manassas, VA
Tom Cat Ultra Pellets	1.5 oz	Place pack /	$1.99	$1.32	Retail stores,

Costs of Rodenticide Baits					
Name	**Amount (# units*size)**	**Form**	**Price Range (Average) ($)**	**Unit Price** ($ per oz)**	**Source**
(Bromadiolone)		pellet			Warrenton and Manassas, VA
Tom Cat Ultra Pellets (Bromadiolone)	16 oz (4*4 oz)	Place pack / pellet	$3.97 – $4.99 ($4.32)	$0.27	Retail stores, Warrenton and Manassas, VA
Tom Cat Ultra Feeder Pac (Bromadiolone)	1.5 oz	Place pack / pellet	$1.99	$1.32	Retail stores, Warrenton and Manassas, VA
Tom Cat Ultra Block Bait (Bromadiolone)	8 oz (8*1 oz)	Block / bar	$2.99 – $3.99 ($3.65)	$0.46	Retail stores, Warrenton and Manassas, VA
Tom Cat Ultra Block Bait (Bromadiolone)	28 oz (28*1 oz)	Block / bar	$11.99	$0.43	Retail stores, Warrenton and Manassas, VA
Tom Cat All-Weather Bait Chunks (Diphacinone)	64 oz	Block / bar	$17.00	$0.27	Retail stores, Warrenton and Manassas, VA
Tom Cat Rodenticide (Diphacinone)	16 oz	Block / bar	$2.58	$0.16	Retail stores, Warrenton and Manassas, VA
Tom Cat Ultra Pelleted Bait (Bromadiolone)	5.3 oz (6*5.3 oz)	Place pack / pellet	$3.39	$0.64	Retail stores, Warrenton and Manassas, VA
Ramik Mouse Pack (Diphacinone)	1oz	Place pack / pellet	0.99	$0.99	Retail stores, Warrenton and Manassas, VA
Ramik Mini Bar (Diphacinone)	8 oz (8*1 oz)	Block / bar	2.59	$0.32	Retail stores, Warrenton and Manassas, VA
Ramik Green (Diphacinone)	16 oz	Place pack / pellet	3.59	$0.22	Retail stores, Warrenton and Manassas, VA
Ramik Green Bait Packs (Diphacinone)	4 oz	Place pack / pellet	1.09	$0.27	Retail stores, Warrenton and Manassas, VA
Real Kill (Bromethalin)	6 oz (12*0.5 oz)	Block / bar	4.88	$0.81	Retail stores, Warrenton and Manassas, VA
Real Kill (Bromethalin)	4.5 oz (6*0.75 oz)	Place pack / pellet	4.97	$1.10	Retail stores, Warrenton and Manassas, VA
Average				**$0.60**	

** Place packs / pellets and bars / blocks are sold in varying sizes, usually from 1 – 2 ounces. To model the costs, BEAD has calculated the cost for a "unit" of one ounce.

Rat Bait Stations			
Product	**Unadjusted Price**	**Unit Price**	**Source**
Tom Cat Rat Station (Tamper-Resistant)	$14.73 to $19.00	$16.87 (avg.)	Retail stores, Warrenton and Manassas, VA
Protecta Sidekick	$41.56 (6)	$6.92	Online retailer
Safeway Rat Baiter	$77.68 (6)	$12.94	Online retailer
SMC Protecta BS Black	$62.57 (6)	$10.43	Online retailer
SMC Protecta BS Gray or Green	$74.07 (6)	$12.35	Online retailer
J.T. Eaton Rat Fortress	$64.71 (6)	$10.79	Online retailer
Average Cost		**$11.71**	

Mouse Bait Stations			
Product	**Unadjusted Price**	**Unit Price**	**Source**
*Tom Cat Ultra Baited Mouse Bait Station Refillable)	3.99	3.34	Retail stores, Warrenton and Manassas, VA
*Hawk Prebaited, Reusable Mouse Bait Station	2.79	2.14	Retail stores, Warrenton and Manassas, VA
SMC Protecta RTU	20.25 (12)	1.68	Online retailer
SMC Protecta Keyless	32.25 (12)	1.69	Online retailer
SMC Protecta Mouse BS	35.47 (12)	2.96	Online retailer
Safeway Mouse Baiter	77.07 (24)	3.21	Online retailer
Average Cost		**$2.50**	

*Unit price of pre-baited stations was reduced by $0.60 to adjust for bait.